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(54) Emission controlled two-cycle engine.

(57) An emission controlled two-cycle internal combustion engine is disclosed. The presence of unburned hydrocarbons and oil smoke is substantially reduced by eliminating the use of lubricating oil in the fuel, confining lubricating oil for the engine to the crankcase, purging exhaust gases from the combustion chamber with pressurized fresh air, and timing the injection of fuel into the combustion chamber to occur near the closure of the exhaust port to eliminate the escape of unburned fuel through the exhaust port.

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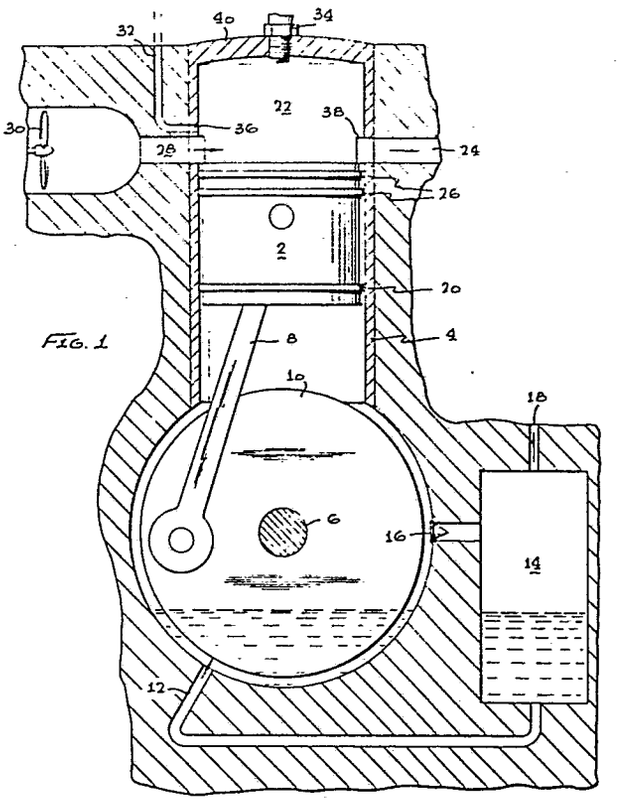

FIG. 1

S P E C I F I C A T I O N

To whom it may concern:

Be it known that JOHN A. ROESCH, JR. also known as JOHN ADAMS and TERRY M. VAN BLARICOM, both citizens of the United States of America, and residing in the County of Los Angeles, State of California, have invented a new and useful

EMISSION CONTROLLED TWO-CYCLE ENGINE

of which the following is a specification.

ABSTRACT OF THE DISCLOSURE

An emission controlled two-cycle internal combustion engine is disclosed. The presence of unburned hydrocarbons and oil smoke is substantially reduced by eliminating the use of lubricating oil in the fuel, confining lubricating oil for the engine to the crankcase, purging exhaust gases from the combustion chamber with pressurized fresh air, and timing the injection of fuel into the combustion chamber to occur near the closure of the exhaust port to eliminate the escape of unburned fuel through the exhaust port.

BACKGROUND OF THE INVENTION

1. Field of The Invention

The present invention is directed to two-cycle internal combustion engines. More particularly, the present invention concerns an emission controlled two-cycle engine wherein the presence of raw fuel, unburned hydrocarbons and oil smoke is substantially eliminated from the exhaust gas of the engine.

2. Description of The Prior Art

As is well known, two-cycle engines contribute substantially more power than four-cycle engines on a per unit volume and/or weight basis. In fact, the difference in power produced by the two types of engines is so great that where

the weight and size of a power plant is important such as in motorcycle racing, the use of four-cycle engines has been all but abandoned.

Four-cycle engines, nevertheless, are used as the principal type of internal combustion engine in today's automobiles, trucks and other passenger vehicles. The reason for this is believed to reside in the substantial amount of pollutants included in the exhaust gases of the conventional two-cycle engine in use today. The high level of pollutants in the exhaust gases of two-cycle engines is principally due to the use of a gasoline-oil mixture as the fuel, as well as the means for purging exhaust gases from the cylinder.

The use of gasoline-oil mixture as the fuel obviously results in burned oil and oil smoke being present in the exhaust gases. Further, the purging of exhaust gases from the combustion chamber using the gasoline-oil mixture that is to be used for the next power stroke results in the escape of some of the gasoline-oil mixture with the exhaust gases.

With the emphasis on clean air and smog control today, it is clear that the two-cycle internal combustion engine is undesirable, or at least highly limited, for use on passenger vehicles unless the exhaust gases of such an engine can be made free of pollutants.

Advances have been steadily made in the technology of internal cumbustion engines and specifically two-cycle internal combustion engines. The following patents exemplify some of the advances made over the years to have two-cycle engines be more efficient and of greater utility:

Cage	No. 1,575,541
Bokemuller	No. 2,113,979
Mallory	No. 2,156,665
Carter	No. 2,381,646
Black	No. 2,799,258
Webb	No. 2,873,574
Brown	No. 3,340,855
Brown	No. 3,340,857
Morton	No. 4,016,838

Notwithstanding the advances made, there still remains a requirement that two-cycle internal combustion engines be made "cleaner" such that the exhaust gases thereof are substantially free of pollutants.

OBJECTS AND SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a two-cycle internal combustion engine that is characterized by a substantial reduction in the amount of pollutants included in its exhaust gases.

It is another object of the present invention to provide a two-cycle internal combustion engine that does not require a gasoline-oil mixture for fuel.

It is a further object of the present invention to provide a two-cycle internal combustion engine in which fresh air rather than a fuel mixture is used to scavenge the combustion chamber.

It is yet another object of the present invention to provide a two-cycle internal combustion engine utilizing the timed injection of fuel for each successive charge.

It is yet another object of the present invention to provide a two-cycle internal combustion engine wherein the crankcase is isolated from the combustion chamber.

More particularly, the subject invention is characterized by the use of a sealing ring around each piston to retain the lubricating oil in the crankcase. The introduction of fuel into the combustion chamber for each successive charge is timed to occur near the closing of the exhaust port leading from the combustion chamber. Following ignition of each charge, fresh air under pressure is forced through the combustion chamber to scavenge the combustion chamber. The result is the elimination of oil smoke and raw fuel or other unburned hydrocarbons from the exhaust gases of the engine.

Further objects and the many attendant advantages of the invention may be best understood by reference to the following detailed description taken in conjunction with the accompanying drawings in which like reference symbols designate like parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional side view of a two-cycle internal combustion engine in accordance with the present invention.

Figures 2 through 6 are a sequence of diagrams also illustrating a cross-sectional side view of the present invention which serves to show operation of a two-cycle engine in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to Figure 1 of the drawings, an emission

controlled two-cycle internal combustion engine, in accordance with the present invention, includes a piston 2 situated to be reciprocated in a cylinder 4. The piston 2 is connected to a crankshaft 6 by a connector rod 8 of conventional design. A conventional crankcase 10 is supplied with lubricating oil through an oil duct 12 connected to an oil sump 14. A one-way valve 16 may be used to have excess oil in the crankcase 10 returned to the oil sump 14. An air vent 18 provided in the oil sump 14 may be used to prevent air locking.

Lubrication of the piston 2 and the bearings (not shown) of the subject two-cycle engine may be accomplished by either a pressure or splash method, both of which are well known in the prior art.

The piston 2 is equipped with a sealing ring 20 which is situated at, and fully encircles, the lower periphery of the piston 2. The sealing ring 20 serves to keep the lubricating oil in the crankcase 10 from escaping therefrom into the combustion chamber 22 or the exhaust port 24 of the engine.

One or more compression rings 26 are provided at the upper periphery of the piston 2.

The combustion chamber 22 is provided with an air input port 28 through which pressurized air may be furnished by a blower 30 or the like for the purpose of scavenging the combustion chamber 22.

Fuel is supplied to the combustion chamber 22 via a fuel input duct 32 which may be appropriately connected to a timed fuel injection system of any conventional design (not

shown). Ignition of the fuel is accomplished by the use of a conventional spark plug 34 which may be connected to a conventional electrical system used with internal combustion engines to be fired in timely fashion.

The fuel input duct 32 communicates with the combustion chamber 22 by having an input port 36 in the side wall of the cylinder 4. Preferably, the fuel input port 36 is situated above the upper edge 36 of the exhaust port 24, such that the exhaust port 24 is nearly closed or blocked by the piston 2 when fuel is injected through the input duct 32 and the port 36 into the combustion chamber 22. A low pressure fuel injection system would be suitable for use if the port 36 is in close proximity to the upper edge 38 of the exhaust port 24. It is to be noted that the higher the input port 36 of the fuel input duct 32 is on the wall of the cylinder 4, the greater amount of pressure will be required to inject the fuel into the combustion chamber. However, the fuel input port 36 could be situated on the head 40 of the cylinder 4 if a high pressure fuel injection system such as is conventionally used on diesel engines is used.

Reference is now made to Figures 2 through 6 for the purpose of describing the operation of the subject two-cycle engine. The downstroke or expansion stroke of the engine is commenced upon ignition of fuel contained in the combustion chamber 22 by firing of the spark plug 34 as is illustrated by Figure 2. Referring to Figure 3, continuation of the downstroke of the piston 2 will result in the opening or uncovering of the exhaust port 38 thereby permitting exhaust gases to escape from the combustion chamber 22. As shown in Figure 4, the opening of the exhaust port 38 is succeeded by the opening or uncovering of the air input

port 28 as the downward movement of the piston 2 continues. The opening of the air input port 28 permits fresh air to be blown into the combustion chamber 22 for the purpose of scavenging the combustion chamber 22. The use of fresh air eliminates the air pollution caused by prior art engines that use successive fuel charges for scavenging.

Upon commencement of the up or compression stroke of the piston 2, as shown in Figure 5, the upward movement of the piston 2 will close or again block the air input port 28 and then the exhaust port 38, as shown in Figure 5. The fuel injection system would be timed in accordance with the present invention to inject a controlled amount of fuel 42 through the fuel input port 36 into the combustion chamber 22. As is well known, the injection of fuel requires a very short period of time. Following such feel injection, the fuel input duct 36 is closed by the piston 2 as the compression stroke is completed, as is illustrated by Figure 6.

Upon the piston 2 reaching the end of the compression stroke, a new cycle will thereafter begin and the spark plug 34 is again fired as illustrated by Figure 2.

From the foregoing description, it is now clear that the subject invention provides an improved emission controlled two-cycle engine. Specifically, the timed injection of pure fuel (rather than a gasoline-oil mixture) near the time of closure of the exhaust port 38, prevents raw fuel from intentionally or accidentially being allowed to escape through the exhaust port 38 and eliminates the presence of oil smoke and other unburned hydrocarbons in the exhaust gases of the engine since oil is not mixed with gasoline.

Additionally, the use of pressurized fresh air to scavenge the combustion chamber 22 instead of a fuel charge, as is conventionally done, further eliminates the potential of raw fuel escaping through the exhaust port with exhaust gases.

Further, the use of a full skirted piston having a sealing ring at the lower periphery thereof prevents lubricating oil from entering the combustion chamber and from escaping through the exhaust port 38. The use of a sealing ring also prevents exhaust gases from entering the crankcase area and thereby prevents possible sludging of the lubricating oil.

It is clear that by confining lubricating oil to the crankcase and preventing escape thereof through the exhaust system, that the consumption of lubricating oil is substantially reduced, the quality of the lubrication oil is able to be preserved for longer periods of time, and fouling of the spark plug 34 is reduced.

The foregoing description of the present invention concerns a preferred embodiment that has been developed to date and it is not intended to be limited with respect to the broad principles involved herein. For example, while a single cylinder engine has been described, multiple cylinder engines using the concept of the present invention may be used.

Various modifications of the present invention are possible. For example and as previously described, the placement of the fuel input port 38 can be located at any of a number of different positions on the wall of the cylinder 4 or the cylinder head 40. Clearly, while the preferred embodi-

ment has been described as involving the injection of fuel at a time when the exhaust port 38 is nearly closed, fuel may be injected after the exhaust port 38 is closed. Further, the timed fuel injection system connected to the fuel input duct 32 may be of any of the various conventional types that are commercially available in the prior art.

While a preferred embodiment of the present invention has been described hereinabove, it is intended that all matter contained in the above description and shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense and that all modifications, constructions, and arrangements which fall within the scope and spirit of the invention may be made.

WHAT IS CLAIMED IS:

1. An improved two-cycle internal combustion engine of the type having at least a cylinder; a piston mounted to be reciprocated in said cylinder; a crankshaft; a connecting rod for connecting said piston to said crankshaft; a crankcase enclosing said crankshaft, said connecting rod and a first end of said cylinder, said crankcase containing lubricating fluid; a head for closing a second end of said cylinder; a combustion chamber being formed by said head, said cylinder and said piston; and a spark plug mounted in said head for controllably igniting fuel in said combustion chamber; said engine further comprising:

sealing means mounted on said piston for preventing lubricating fluid in said crankcase from entering said combustion chamber;

venting means for removing exhaust gases from said combustion chamber; and

fuel means for controllably injecting fuel into said combustion chamber.

2. The improved two-cycle internal combustion engine defined by Claim 1, said sealing means comprising:

a seal ring mounted on said piston and surrounding the lower periphery thereof, said seal ring being in slideable contact with said cylinder.

3. The improved internal combustion engine defined by Claim 1, said cylinder having side walls, said venting means comprising:

an exhaust port and an air intake port situated in said side walls of said cylinder and pe-

riodically communicating with said combustion chamber under the control of the reciprocation of said piston in said cylinder; and

blower means for blowing air through said air intake port into said combustion chamber for scavenging said combustion chamber when said air intake port and said exhaust port are in communication with said combustion chamber.

4. The improved two-cycle internal combustion engine defined by Claim 1, said fuel means comprising:

a timed fuel injector for periodically injecting fuel into said combustion chamber.

5. The improved two-cycle internal combustion engine defined by Claim 4, wherein said fuel is gasoline.

6. The improved two-cycle internal combustion engine defined by Claim 4, said cylinder having side walls, wherein said timed fuel injector includes a fuel intake port situated in the side wall of said cylinder and periodically communicating with said combustion chamber under the control of the reciprocation of said piston in said cylinder.

7. The improved two-cycle internal combustion engine defined by Claim 3, said sealing means comprising:

a seal ring mounted on said piston and surrounding the lower periphery thereof, said seal ring being in slideable contact with said cylinder.

8. The improved two-cycle internal combustion engine defined by Claim 7, said fuel means comprising:

a timed fuel injector forperiodically in-

jecting fuel into said combustion chamber.

9. The improved two-cycle internal combustion engine defined by Claim 8, wherein said timed fuel injector includes a fuel intake port situated in the side wall of said cylinder and periodically communicating with said combustion chamber under the control of the reciprocation of said piston in said cylinder, said piston having an upstroke and a downstroke wherein said air intake port, said exhaust port, and said fuel intake port are periodically covered and uncovered by said piston when reciprocating, said fuel intake port being positioned on said side wall of said cylinder to remain temporarily uncovered during a period when said exhaust port is covered by said piston.

10. A two-cycle internal combustion engine having:

a combustion chamber; a spark plug extending therein; a piston slideable within said combustion chamber; at least one botton seal ring disposed about the periphery of said piston; a crankcase; an intake manifold independent of said crankcase; means to pressurize air within said intake manifold; an air purge port providing gaseous communication between said combustion chamber and said intake manifold; an exhaust port; and timed means to inject fuel into said combustion chamber.

11. The two-cycle internal combustion engine defined by Claim 10 wherein said air purge port and said exhaust port are positioned in said combustion chamber such that the side of said air purge port which is furthest from said crankcase is closer to said crankcase than the similar side of said exhaust port such that said piston, upon its upstroke,

away from said crankcase, closes said air purge port before it closes said exhaust port.

12. The two-cycle internal combustion engine defined by Claim 11 wherein said means to inject fuel into said combustion chamber consists of a gasoline duct in gaseous communication with said combustion chamber and conventional electronic or mechanical timing means to inject said fuel into said combustion chamber at a time in the cycle near closure of said exhaust port wherein the escape of unburned gasoline out said exhaust port is prevented.

13. A two-cycle combustion engine having:

(a) a cylinder defining a combustion chamber:

(b) a cylinder head;

(c) a spark plug protruding through said combustion chamber;

(d) a piston slideable within said combustion chamber;

(e) at least one bottom seal ring on said piston;

(f) a crankcase;

(g) an intake manifold independent of said crankcase;

(h) an intake fan to pressurize air within said intake manifold;

(i) an air purge port providing gaseous communication between said combustion chamber and said intake manifold, said purge port being substantially rectangular in configuration;

(j) an exhaust port substantially rectangular in configuration, located sub-

stantially opposite said purge port;

(k) a gasoline duct in gaseous communication with said combustion chamber; located substantially above said air purge port;

(l) means to inject fuel, via said gasoline duct, into said combustion chamber after the air purge port is closed by upstroke of said piston, and immediately before said exhaust port is closed; and

(m) a crankcase lubrication system comprising an oil sump, an oil duct providing fluid communication between said oil sump and said crankcase, a one-way valve to allow excess oil from said crankcase to return to said oil sump, and an air vent.

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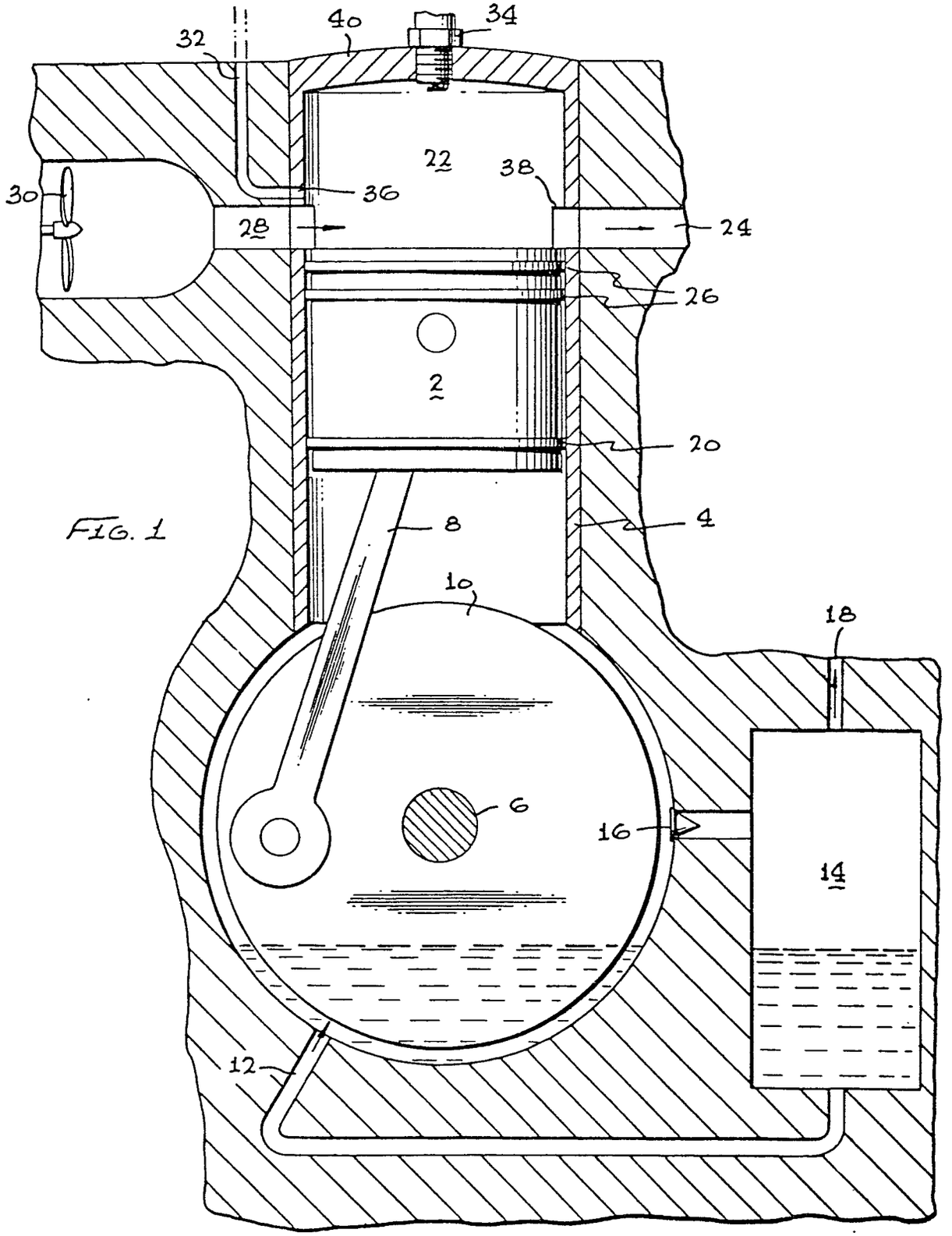

FIG. 1

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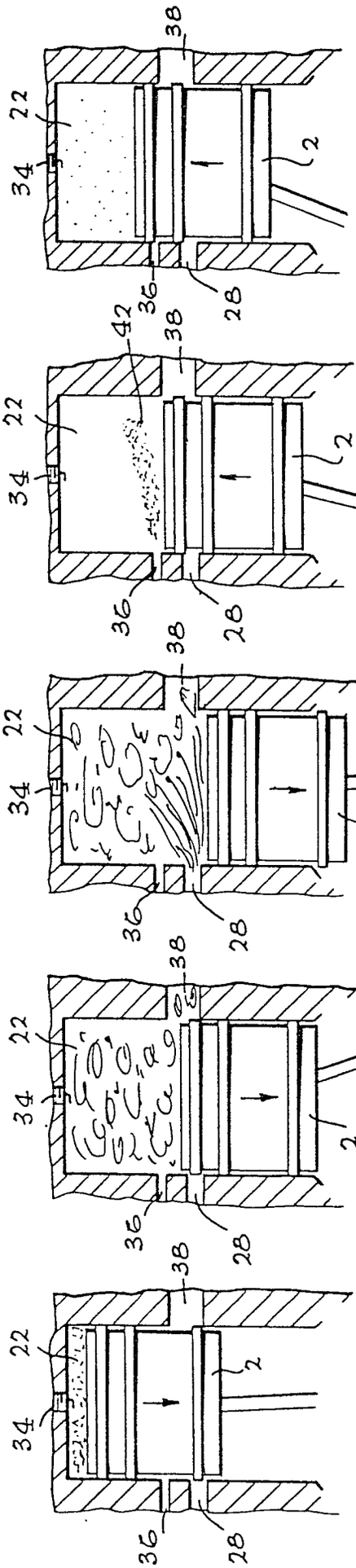

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6